

**Final Performance Report
NAG5-11360**

Date: December 23, 2002

PI: Ronald J. Allen, Space Telescope Science Institute

NASA Grant No: NAG5- 11360

Title: *A Study of Imaging Interferometer Simulators*

STScI Project No: J0352

Performance Pd: 10/01/01 - 09/30/02

**STScI Grant
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Summary of Project Activities

"A STUDY of IMAGING INTERFEROMETRY SIMULATORS" NAG5-11360

Introduction:

Several new space science mission concepts under development at NASA-GSFC for astronomy are intended to carry out synthetic imaging using Michelson interferometers or direct (Fizeau) imaging with sparse apertures. Examples of these mission concepts include the Stellar Imager (SI), the Space Infrared Interferometric Telescope (SPIRIT), the Submillimeter Probe of the Evolution of Cosmic Structure (SPECS), and the Fourier-Kelvin Stellar Interferometer (FKSI).

We have been developing computer-based simulators for these missions. These simulators are aimed at providing a quantitative evaluation of the imaging capabilities of the mission by modelling the performance on different realistic targets in terms of sensitivity, angular resolution, and dynamic range. Both Fizeau and Michelson modes of operation can be considered. Our work is based on adapting a computer simulator called imSIM, which was initially written for the Space Interferometer Mission in order to simulate the imaging mode of new missions such as those listed. In a recent GSFC-funded study we have successfully written a preliminary version of a simulator SISIM for the Stellar Imager and carried out some preliminary studies with it. In a separately funded study we have also been applying these methods to SPECS/SPIRIT.

Work accomplished:

In the last year of support under the grant referenced above, we have extended and improved the simulator for the Stellar Imager, incorporating several new features into it as requested by the PI Dr. Ken Carpenter, and made a start at writing a simulator for the FKSI mission.

Improvements to SISIM:

SISIM initially modelled only photon noise. The possibility to include various instrument errors such as errors in positions of the individual apertures and errors in the calibration of the visibilities has now been added into the code. These additions permit more realistic estimates to be made of the sensitivity and dynamic range for a variety of targets. Some minor modifications to the default parameters like aperture positions, wavelengths etc have been done, and output files are provided now in PNG format as well. We have also added flexibility in the method of choosing the array configuration.

A major addition since the last report is a new noise "widget" suitable for Fizeau operation. We can now quantitatively estimate image degradation for a range of probable errors, both in phase and in amplitude, at the individual apertures. A poster paper was presented at the recent SPIE meeting in Kona demonstrating the basic aspects of this capability.

The code for the "SIsim" simulator was provided to GSFC in the spring of 2002.

A Preliminary Version of FKSI:

We have made a start on a simulator for FKSI with much the same general capabilities as SIsim, except for physical parameters such as mirror size, wavelength of operation, etc. FKSI will differ from the other simulators in the kind of noise models needed. The noise widget available is flexible enough to implement a variety of noise sources, including IR background as an amplitude perturbation at the apertures.

A thorough testing of all the features provided in FKSIsim remains to be carried out.

In Conclusion:

A paper was read at the SPIE meeting in Kona last summer describing the work carried out under this grant (Allen, R. J., Boeker, T., & Rajagopal, J. 2003, "Simulators for Imaging Interferometry in Space", SPIE, Kona).

The code provided under this grant remains the intellectual property of the Space Telescope Science Institute and cannot be further distributed without the express agreement of the PI, Dr. Ronald J. Allen.

FEDERAL CASH TRANSACTIONS REPORT		OMB APPROVAL NO. 0348-0003																					
<i>(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272A.)</i>		1. Federal sponsoring agency and organizational element to which this report is submitted NASA Goddard Space Flight Center Accounting Branch Code 151-2 Greenbelt MD 20771																					
2. RECIPIENT ORGANIZATION Name: Space Telescope Science Institute Number and Street: 3700 San Martin Drive City, State and ZIP Code: Baltimore, MD 21218		4. Federal grant or other identification number NAG5-11360	5. Recipient's account number or identifying number J0352																				
		6. Letter of credit number 80005122	7. Last payment voucher number n/a																				
Give total number for this period																							
		8. Payment Vouchers credited to your account	9. Treasury checks received (whether or not deposited)																				
10. PERIOD COVERED BY THIS REPORT																							
3. FEDERAL EMPLOYER IDENTIFICATION NO. 86-0138043		FROM (month, day, year) 10/1/2001	TO (month, day, year) 9/30/2002																				
11. STATUS OF FEDERAL CASH <i>(See specific instructions on the back)</i>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;">a. Cash on hand beginning of reporting period</td> <td style="width: 30%; text-align: right; padding: 5px;">\$ 0.00</td> </tr> <tr> <td style="padding: 5px;">b. Letter of credit withdrawals</td> <td style="text-align: right; padding: 5px;">31,788.67</td> </tr> <tr> <td style="padding: 5px;">c. Treasury check payments</td> <td style="text-align: right; padding: 5px;">0.00</td> </tr> <tr> <td style="padding: 5px;">d. Total receipts (Sum of lines b and c)</td> <td style="text-align: right; padding: 5px;">31,788.67</td> </tr> <tr> <td style="padding: 5px;">e. Total cash available (Sum of lines a and d)</td> <td style="text-align: right; padding: 5px;">31,788.67</td> </tr> <tr> <td style="padding: 5px;">f. Gross disbursements</td> <td style="text-align: right; padding: 5px;">31,788.67</td> </tr> <tr> <td style="padding: 5px;">g. Federal share of program income</td> <td style="padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">h. Net disbursements (Line f minus line g)</td> <td style="text-align: right; padding: 5px;">31,788.67</td> </tr> <tr> <td style="padding: 5px;">i. Adjustments of prior periods</td> <td style="text-align: right; padding: 5px;">0.00</td> </tr> <tr> <td style="padding: 5px;">j. Cash on hand end of period</td> <td style="text-align: right; padding: 5px;">\$ 0.00</td> </tr> </table>			a. Cash on hand beginning of reporting period	\$ 0.00	b. Letter of credit withdrawals	31,788.67	c. Treasury check payments	0.00	d. Total receipts (Sum of lines b and c)	31,788.67	e. Total cash available (Sum of lines a and d)	31,788.67	f. Gross disbursements	31,788.67	g. Federal share of program income		h. Net disbursements (Line f minus line g)	31,788.67	i. Adjustments of prior periods	0.00	j. Cash on hand end of period	\$ 0.00
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12. THE AMOUNT SHOWN ON LINE 11j, ABOVE, REPRESENTS CASH REQUIREMENTS FOR THE ENSUING Days	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="padding: 5px;">13. OTHER INFORMATION</td> </tr> <tr> <td style="width: 70%; padding: 5px;">a. Interest income</td> <td style="width: 30%; text-align: right; padding: 5px;">\$</td> </tr> <tr> <td style="padding: 5px;">b. Advances to subgrantees or subcontractors</td> <td style="text-align: right; padding: 5px;">\$</td> </tr> </table>			13. OTHER INFORMATION		a. Interest income	\$	b. Advances to subgrantees or subcontractors	\$														
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14. REMARKS <i>(Attach additional sheets of plain paper, if more space is required)</i> Total award amount \$32,000.00 FINAL 272 report for J0352																							

15. CERIFICATION			
I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.	AUTHORIZED	SIGNATURE	DATE REPORT SUBMITTED 02/20/2003
	CERTIFYING	TYPED OR PRINTED NAME AND TITLE Amy Garrett Power	TELEPHONE (Area Code, Number, Extension) 410-338-4801
	OFFICIAL	Accountant apower@stsci.edu	

THIS SPACE FOR AGENCY USE

Space Telescope Science Institute
Final Property/Inventory Report for Grant Number
NAG5 – 11360
STScI Project No.: J0352
As of 11/13/02

For dollar values greater than 5,000.00 and less than 100,000,000.00

Negative Report

NASA GRANTEE NEW TECHNOLOGY SUMMARY REPORT

NASA requires each research grantee, research contractor, and research subcontractor to report new technology to the NASA Commercial Technology Office. For that purpose, the following reports and corresponding schedules are provided:

<u>Title of Report</u>	<u>Form Number</u>	<u>Timetable</u>
New Technology Disclosure	NASA Form 1679	The grantee discloses <i>each</i> discovery of new technology individually, at the time of its discovery
NASA Grantee New Technology Summary Report (checkmarked "Interim")	NASA C-3043	For multi-year grants, the grantee summarizes the previous year's disclosures on an annual basis. The first Interim New Technology Summary Report is due exactly 12 months from the effective date of the grant. Future reports are due annually, thereafter.
NASA Grantee New Technology Summary Report (checkmarked "Final")	NASA C-3043	The grantee submits a cumulative summary of all disclosed technologies. The Final New Technology Summary Report is submitted immediately following the grant's technical period of performance.

Grantee Name: Dr. Ronald J. Allen

Grantee Address: Space Telescope Science Institute

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Telephone No.: (410) 338-4586

NASA Grant No: NAG5-11360

Grant Completion Date: 09/30/02

NASA GM: Kenneth Carpenter

Report Submitted by: Joy Hayes McQuay

New technology should be reported whether or not it is or may be patentable.

Large business contractors and subcontractors must disclose all reportable items to NASA. Reportable items as used in NASA contracts (or subcontracts) with large businesses means any invention, discovery, improvement, or innovation, whether or not patentable, conceived or first actually reduced to practice in the performance of work under a NASA contract (or subcontract). Reportable items include, but are not limited to, new processes, machines, manufactures, and compositions of matter, and improvements to, or new applications of, existing processes, machines, manufactures, and compositions of matter. Reportable items also include new computer programs, and improvements to, or new applications of, existing computer programs, whether or not copyrightable.

Small business, nonprofit organization, and college and university contractors and subcontractors must disclose all subject inventions to NASA. Subject inventions as used in NASA contracts (or subcontracts) with other than large businesses means any invention or discovery which is or may be patentable and is conceived or first actually reduced to practice in the performance of work under a NASA contract (or subcontract). Subject inventions include any new process, machine, manufacture, or composition of matter, including software, and improvements to, or new applications of, existing processes, machines, manufactures, and compositions of matter, including software.

Subject to approval by contractors (or subcontractors) who retain or obtain title to subject inventions or reportable items, all such reported items are evaluated for publication in NASA Tech Briefs. If an item is published in NASA Tech Briefs, the innovator receives a monetary award from NASA.

NASA GRANTEE NEW TECHNOLOGY SUMMARY REPORT

General Information

1. Type of Report: ☐ Interim ☒ Final Reporting Period: 10/01/01 – 09/30/02
2. Size of Business: ☐ Large ☐ Small ☐ College/ University ☒ Nonprofit Organization
3. Have any reportable items or subject inventions resulted from work performed under this contract during this reporting period? ☐ Yes ☒ No
4. Are New Technology Items being disclosed (NF 1679 or equivalent) with this Summary Report?
☐ Yes ☒ No

• New Technology Items

Please provide the title(s) of all new and previously disclosed new technology items conceived or first reduced to practice under this grant. Use a separate piece of paper if additional space is required.

<u>Title</u>	<u>Internal Docket Number</u>	<u>Patentable Item</u>	<u>Patent Appl. Filed</u>	<u>Patent Appl. Not Filed</u>
• NONE		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• _____	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• _____	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• _____	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

• Grant Subcontractors

Please complete the following section listing all research subcontractors participating to date. Include each subcontractor's name, address, contact person, telephone number, and the subcontract award date. Use a separate piece of paper if additional space is required.

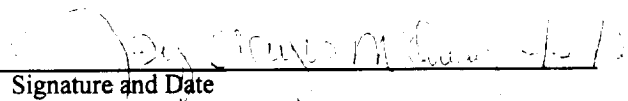
NONE

<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Date of Award: _____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Date of Award: _____</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Date of Award: _____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Date of Award: _____</p>
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• Certification

I certify that active and effective procedures ensuring prompt identification and timely disclosures of reportable new technology items have been followed. Furthermore, I certify that all new technology items required to be disclosed and conceived during the period identified on this form have been disclosed to NASA.

Joy Hayes McQuay
Sponsored Programs Administrator I
Name and Title of Authorized Official


Signature and Date